DOCUMENT RESUME

ED 350 175 SE 053 375

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TITLE Students at Risk in Mathematics: Prevention and Recovery in Elementary Schools.
INSTITUTION ERIC Clearinghouse for Science, Mathematics, and Environmental Education, Columbus, Ohio.
SPONS AGENCY Office of Educational Research and Improvement (ED), Washington, DC.
PUB DATE Oct 92
CONTRACT RI88062006
NOTE 61p.
AVAILABLE FROM ERIC Clearinghouse for Science, Mathematics and Environmental Education, 1200 Chambers Road, Suite 310, Columbus, OH 43212 ($7.50).
PUB TYPE Information Analyses - ERIC Clearinghouse Products (071)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS Achievement Need; *At Risk Persons; Attitude Change; Community Involvement; Dropout Characteristics; Early Intervention; Elementary Education; *Elementary School Students; Improvement Programs; Instructional Materials; Mathematics Achievement; Mathematics Education; *Mathematics Instruction; Parent Participation; *Prevention; *Remedial Mathematics; *Remedial Programs; School Involvement; Student Attitudes; Teacher Student Relationship; Teaching Methods
IDENTIFIERS *Remedial Intervention

ABSTRACT

This monograph provides an overview of the characteristics, attributes, and behaviors that define and identify elementary school students who are at risk of not succeeding in mathematics. The monograph is divided into seven sections that report research to support early intervention procedures to prevent problems from developing and suggest programs, practices, and materials to prevent or reduce problems. Section I, the introduction, identifies two groups of students to whom these programs would apply: the "typical" potential dropout or underachiever and the "nominal" mathematics student who reaches inadequate levels of mathematics achievement to allow him or her maximum educational and life choices. Section II describes some of the variables related to problems of at-risk students in mathematics. Sections III-V describe practices and programs that prevent or reduce at-risk problems related to mathematics achievement from three perspectives: the impact made by schools or organizations; the impact made in the classroom; and the impact made by instructional materials. Section VI describes changes that can be made by schools and individuals in response to the evaluation of present practice. Actions suggested include school restructuring; curriculum modifications; and changes in instructional programs, instructional materials, support services, and parental and community involvement. Section VII provides a list of selected organizational resources to contact for information related to at-risk students. (Contains over 70 references.) (MDH)

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Students at Risk in Mathematics: Prevention and Recovery in Elementary Schools

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October 1992

Produced by the

ERIC Clearinghouse for Science, Mathematics and Environmental Education
The Ohio State University
1200 Chambers Road, Third Floor
Columbus, OH.

PRINTED WITH SOY INK

Cite as:

Howe, Robert W. & Kasten, Margaret (1992). *Students at risk in mathematics: Prevention and recovery in elementary schools.* Columbus, OH: ERIC Clearinghouse for Science, Mathematics, and Environmental Education.

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Dorothy E. Myers, *U. S. Department of Education Reviewer*
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This publication was funded by the Office of Educational Research and Improvement, U.S. Department of Education under contract no. RI-88062006. Opinions expressed in this publication do not necessarily reflect the positions or policies of OERI or the Department of Education.

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Table of Contents

I INTRODUCTION 1

II WHAT ARE SOME OF THE VARIABLES RELATED TO PROBLEMS OF AT-RISK STUDENTS IN MATHEMATICS? 3
Variables Related to Problems of Potential Dropouts in Mathematics 3
Variables Related to Problems of Nominal Mathematics Students 4

III WHAT ARE SOME SCHOOL EMPHASES, ORGANIZATIONAL APPROACHES, PRACTICES AND PROGRAMS TO PREVENT AND TO REDUCE AT-RISK PROBLEMS RELATED TO MATHEMATICS ACHIEVEMENT? 7
What are Characteristics of Successful School Programs? 7
What are Some Materials, Programs and Interventions for Preventing and Reducing Problems of At-risk Students? 7
Prevention, recovery, and re-entry 8
Curriculum and program modification 9
Instructional practices 13
Selected policies related to at-risk pupils 15
How Can Parents and the Community be Involved to Prevent or to Reduce At-risk Problems Related to Mathematics Achievement? 18

IV WHAT ARE CLASSROOM PRACTICES THAT PREVENT OR TO REDUCE AT-RISK PROBLEMS RELATED TO MATHEMATICS ACHIEVEMENT? 21
Instructional and Management Practices to Develop and Improve Pupil Attitudes Toward Mathematics 21
Self-confidence related to mathematics 22
Future goals and expectations 22
Study skills, effort, persistence 23
Positive teacher/pupil relationships 24
Developing positive interests for mathematics and the use of mathematics 24

V WHAT ARE SOME PROGRAMS AND MATERIALS THAT CAN PREVENT OR TO REDUCE AT-RISK PROBLEMS RELATED TO MATHEMATICS ACHIEVEMENT? 27
Programs and Materials Included in the National Diffusion Network 27
A Selection of Other Programs and Materials 38
Computer Instructional Systems and Computer Software 42

VI WHAT SHOULD YOUR SCHOOL DO? WHAT SHOULD YOU DO? 43
School Level Assessment and Program Modification 43
Classroom and program modification 44
Making Contacts for Ideas and Assistance 44

VII SELECTED RESOURCES FOR INFORMATION RELATED TO AT-RISK STUDENTS 45

VIII References 49

IX Bibliography 51

Preface

At-risk students have become a major concern of teachers, parents, businesses, industries, and politicians. An increasing number of students are at risk of not succeeding in school and in life, and the problems associated with this condition are becoming more severe. Variables have been identified that relate to failure in school, dropping out of school, or not learning needed knowledge and skills. Some effective programs, interventions, and materials have been identified.

This monograph provides an overview of the characteristics, attributes, and behaviors that define and identify children who are at-risk in mathematics. Research data support early intervention procedures to prevent problems from developing and providing programs and materials to help children and youth who are not succeeding as well as they should. Suggestions for programs, practices, and materials to prevent or reduce problems are presented.

We appreciated the assistance of the many people who provided us with information, descriptions, and evaluations of programs and materials for helping at-risk students in mathematics.

I. INTRODUCTION

Two groups of students in schools are learning substantially less mathematics than they should. The first group consists of the "typical" or "usual" potential school dropout and underachiever. The second group, a group we call "nominal" mathematics students, stays in high school and may even go on to college, but their mathematics education is not adequate to allow them maximum educational and life choices. Both of these types, the potential dropout and the nominal mathematics student, are at risk of not developing adequate mathematical knowledge and skills and contributing less than what they might to their own lives and to society.

What can a school staff do to address the problems of these at-risk students? This publication presents information on the characteristics of these students, some of the causes of their problems, and describes some programs and materials that have been found to be effective in preventing and reducing problems of those at-risk students.

II. WHAT ARE SOME OF THE VARIABLES RELATED TO PROBLEMS OF AT-RISK STUDENTS IN MATHEMATICS?

There are several variables that are believed to cause students to fall into the at-risk groups related to mathematics. Several of these variables can be prevented or modified to help make students more successful in school and in mathematics in particular.

Variables Related to Problems of Potential Dropouts in Mathematics

Data have been accumulated and analyzed related to the numbers and characteristics of potential dropouts. Recent data indicate over 20 percent of the students who enroll in American schools become part of this group.

Some of the variables related to problems of the potential dropout in mathematics are related to at-risk students in general, while others are more specifically related to difficulties with mathematics. Important variables related to the home include:

1. A family pattern of cyclical poverty.
2. Low parental expectations of success.
3. A family pattern of dropouts.
4. Problems in the family related to alcohol, drugs, and child abuse.
5. Parent(s) with less than a high school education.
6. English not being the primary language in the home.
7. Living in a single-parent home.

Important variables related to the individual include:

1. A home with characteristics listed in the above variables.
2. Achievement of more than one year below grade level in reading or mathematics for those in grades K-7 and two years, for those in grades 8-12.
3. Low self esteem.
4. Personal use of drugs and alcohol at an early age.
5. Physical or emotional problems creating need for special help.
6. Low personal expectations.
7. Poor school attendance record.
8. Lack of attention to school activities.
9. Low grades in school.
10. Dislike for school.
11. Discipline problems in school.
12. Legal problems at an early age with police.

13. Early pregnancy, if a girl.
14. Lack of persistence.
15. Learning disability in mathematics.
16. Poor study skills and habits.
17. Lack persistence in difficult tasks.

Important variables related to the school include:

1. Being placed in a lower academic track.
2. Inappropriate curriculum.
3. Small amount of homework assigned.
4. Lack of programs to work with at-risk students.
5. Involvement in a school where a high percentage of students have problems and become drop-outs (poor school climate).
6. Students learning to be unsuccessful.
7. Students developing math anxiety.
8. Instruction that is not diagnostic.
9. Rate of learning that is too fast.
10. Peer pressure to perform poorly.
11. Low school academic expectations.

Studies analyzing these variables indicate at-risk students develop poor achievement patterns and become dropouts because of a complex set of conditions. A large majority of these students are affected by economic, social, and academic problems. Solutions to help these students need to:

1. Modify the school curriculum, instruction and services.
2. Work with the home and the community to prevent problems from developing and to alleviate problems that do develop.

Prevention of problems is more successful than remediation, but effective school programs need to have intervention strategies for students who develop problems in spite of prevention programs.

Variables Related to Problems of Nominal Mathematics Students

Analysis of National Assessment of Educational Progress (NAEP) data (Dossey, Mullis, Lindquist, & Chambers, 1988) and achievement test scores from states indicate that from 20 to 25 percent of the school population that completes high school has not learned fundamental knowledge and skills in mathematics. These youths have not learned mathematical concepts and skills needed to pursue further mathematics; they also have not learned many concepts and skills needed to function effectively in jobs requiring the use of basic mathematical knowledge and skills. These students are not likely to continue in mathematics beyond basic

requirements in high school, nor are they likely to consider a career that uses mathematics.

There are several variables related to the problems of the nominal mathematics student. While some of these are the same as those that pertain to the potential dropout, several are different (the potential dropout may complete high school and in effect become a nominal mathematics student.)

Important home and student variables include:

1. Low parental expectations for experience and success in mathematics.
2. Achievement of more than one year below grade level in mathematics.
3. Low personal expectations related to mathematics.
4. Mathematics anxiety;
5. Learning disability related to mathematics.
6. Poor study skills and habits.
7. Test anxiety.
8. No sense of relevance of mathematics to their lives.
9. Little persistence on difficult tasks.

Important variables related to the school include:

1. Inappropriate curriculum;
2. Students developing math anxiety;
3. Instruction not being diagnostic;
4. Rate of instruction being too fast;
5. Peer group not valuing academic achievement;
6. Peer group not valuing mathematics;
7. Lack of significant school role models;
8. Lack of programs to encourage enrollment in more mathematics in high school.
9. Lack of counseling in transition to secondary grades.

Analyses of these variables indicate both social and academic influences. Solutions to prevent the development of these influences should include (1) curricular, instructional, and service modifications for all students, and (2) special programs that address the needs of particular groups of students such as minorities, girls, students from poverty and low economic homes, students with academic ability (but low achievement) and students with aspirations for careers that do not require higher education.

III. WHAT ARE SOME SCHOOL EMPHASES, ORGANIZATIONAL APPROACHES, PRACTICES AND PROGRAMS TO PREVENT AND TO REDUCE AT-RISK PROBLEMS RELATED TO MATHEMATICS ACHIEVEMENT?

What are Characteristics of Successful School Programs?

School programs that are successful in preventing and reducing problems of potential at-risk students are the result of extensive needs assessment, careful planning and program development, commitment and involvement of administration and staff, commitment and involvement of parents and the community, involvement of students in planning and program development, and continual assessment and modification of policies and programs. Effective at-risk prevention and reduction programs should begin with preschool children and continue throughout the school program. Programs should be provided for prevention, recovery when problems do occur, and reentry to the school program for individuals who have dropped out of school.

School programs that are successful with at-risk students frequently have many characteristics in common. Some programs that include these characteristics are described in the program section of this monograph. Characteristics of successful programs include the following:

1. A strong school commitment to helping all children.
2. Curricular goals and objectives to guide the school program.
3. Relevant and appropriate curriculum based on academic, social, health, personal, and career needs of the student.
4. Strong emphasis on reading, mathematics, and communication skills.
5. Enrichment experiences for students, not just remediation.
6. Coordinated and monitored programs.
7. Modification of programs based of effects on students.

What are Some Materials, Programs and Interventions for Preventing and Reducing Problems of At-risk Students?

Although more research and development is needed to improve the design and implementation of effective programs and practices, several interventions have been effective in a variety of settings and can provide models that can be adapted to other sites. A selection of materials, programs and approaches are described in this section.

Prevention, recovery, and re-entry

Prevention is usually more effective than remediation, and more resources need to be devoted to programs and interventions that prevent problems from occurring.

Programs that begin with the preschool child and continue into the elementary grades have demonstrated substantial success in many sites and need to be strengthened and expanded. Data indicate a high correlation between the students' level of achievement in mathematics in grades 3-5 and later mathematics achievement and enrollment in mathematics. Headstart programs have been effective prevention programs in many sites, though results have not been consistent at all sites. Follow-up studies indicate young people who have been involved in these programs have significantly more success in school and fewer problems than similar groups of students who have not been involved in similar programs. Other preschool programs have also had success.

Variables that appear to be important in preschool programs include emphasis on:

1. Language and communication, including speaking, listening, reading and writing.
2. Developing or improving self-esteem.
3. Developing ability to attend to and to persist on activities.
4. Beginning the development of fundamental concepts.
5. Developing social skills.
6. Identifying and assisting pupils with special needs whether academic, physical, emotional, or social.

Most effective preschool programs have a low teacher-to-pupil ratio and provide a variety of concrete and first-hand experiences.

Prevention programs have also been established in the elementary grades. Effective prevention programs include a relevant and appropriate school curriculum, effective instruction, and a positive school climate for all curricular subjects including mathematics.

The NCTM Curriculum and Evaluation Standards for School Mathematics (1989) provides suggestions for effective mathematics programs. NCTM suggests that emphasis should be placed on concepts, analysis, problem-solving, applications, and communication. The curriculum should be designed to be developmental and engage students actively in learning. The curriculum should be designed to increase the student's ability to learn more advanced material, make the school experience more satisfying, broaden the interest of the student and develop more positive attitudes toward further learning and study.

Although a good school program is usually effective for most students, and should be the first priority, some pupils will not achieve at a satisfactory level. Reasons for lack of success may be due to academic problems, social or school problems, home and/or family problems, or personal problems.

Effective programs need to have mechanisms for early identification of students, diagnosis of specific problems, and procedures and materials for assisting the pupil. Several alternatives are considered in the following sections of this publication.

Curriculum and program modification

There is substantial evidence that the curriculum and the instructional materials used in many schools have produced students with less than desired levels of achievement. Secondly, publications calling for reform in school mathematics for at least the past 15 years have indicated the need for emphasis on new goals for education and new goals for students. Several sources of information and programs are available to help a school reorganize its curriculum.

NCTM Curriculum and Evaluation Standards. The Curriculum and Evaluation Standards for School Mathematics (1989) stress that all students need to:

1. Learn to value mathematics.
2. Become confident in their ability to do mathematics.
3. Become mathematical problem solvers.
4. Learn to communicate mathematically.
5. Learn to reason mathematically.

The intent of these goals is that the student become mathematically literate.

The NCTM Curriculum Standards provide recommendations for three grade clusters: K-4, 5-8, and 9-12. Each standard considers:

1. Mathematical content.
2. Expected student activities.
3. A discussion, with examples, of content and instruction.

The mathematical content stresses "doing" mathematics as well as "knowing" mathematics. The writers of the Standards advocate using activities that have a purpose to help students gather, discover, and create knowledge. The Standards also stress providing experiences that help develop an understanding of mathematics applicable to other disciplines and to use current technology in class, such as calculators and computers, because technology has made calculating and graphing easier and also because technology has changed the nature of problems that are important in mathematics and methods used in investigating problems.

The Standards recommend that student activities grow out of problem situations and that learning should stress active involvement in the learning of mathematics. This constructivist view of learning mathematics stresses:

1. Use of project work.
2. Group and individual assignments.
3. Discussions between teacher and students and among students.

4. Practice on mathematical methods.
5. Exposition by the teacher.

The first three standards in each section are labeled problem solving, communication, and reasoning. The fourth standard is mathematical connections. The connection standards stress connecting ideas and procedures within mathematics and with other content areas.

The writers of the standards believe that substantial reform is needed in K-4 mathematics. They view the current K-4 curriculum as:

1. Narrow in scope.
2. Failing to foster mathematical insight, reasoning, and problem solving.
3. Emphasizing rote activities.

Recommendations are provided for the K-4 curriculum related to content to be included, instruction, use of technology for instruction and learning, and needed resources. Content recommendations include topics, concepts, and practices that should receive increased attention and those that should have less attention.

The writers of the standards believe that many students view the current mathematics curriculum in grades 5-8 as irrelevant, dull and routine. Many current textbooks are viewed as providing a repetition of topics, approach, and level of presentation year after year. In addition, important new material in mathematics such as probability, statistics, geometry, and pre-algebra is not integrated into the curriculum, but left to the last part of the textbook. They believe that the curriculum needs to be shifted to a broader focus. Recommendations are provided for the 5-8 curriculum as for the K-4 curriculum. These recommendations are to help achieve curricular and instructional materials that will reduce these problems.

The standards provide a framework for curriculum development and curriculum modification. Suggestions are provided for:

1. Goals, objectives, and content.
2. Emphases and relationships.
3. Instructional approaches and activities.
4. Articulation across grades.
5. Assessment methods and techniques.
6. Technological tools and resources.

Several states and local school districts have initiated activities to review curricula and instruction, identify instructional materials that are available to implement the standards, and assist schools in curriculum development and modification.

University of Chicago School Mathematics Program (UCSMP) The University of Chicago School Mathematics Program (UCSMP) has developed a curriculum and instructional materials that meet many of the standards recommended by the NCTM. The UCSMP provides greater depth on several mathematical topics, stresses the usefulness of mathematics, provides real problems and applications, reduces the emphasis on computation skills by using calculators and other technology.

Effective and successful schools. Effective and successful schools research has highlighted a number of variables that are usually associated with schools that have improved student achievement and reduced student problems. Analyses of many of the needs of at-risk children indicate that they are matched by practices and conditions of fully implemented effective schools. Data from several studies (Brodinsky, 1989; Crisci, 1986; Druian, 1987) indicate that student achievement, attendance rates, attitudes toward school, and drop out rates have been improved in schools that have implemented effective schooling practices.

The characteristics of a fully implemented effective schools program include several of the following characteristics (Druian & Butler, 1987):

1. High expectations for all students.
2. Goals that are achievable.
3. A curriculum that is aligned with the goals.
4. Effective instruction that is aligned with the goals.
5. Frequent monitoring of student progress.
6. Procedures and programs for assisting students who are not making satisfactory progress.
7. Emphasis on learning.
8. Clear and fair rules and enforcement of rules.
9. Strong administrative and/or staff leadership.
10. Administrative and staff commitment.
11. Staff development program to maintain improvement activities.

A strength of several of the effective school programs, and one that is being developed in others, is a strong emphasis on staff development, collegiality, and communication among and between administration, staff, pupils, parents, and the community. Because at-risk pupils may have problems with several aspects of their lives, programs that incorporate all aspects of the pupil's life are being developed and encouraged.

Accelerated schools and accelerated programs. Many pupils enter secondary grades and lack knowledge, social and academic skills, and the motivation and attitudes needed to succeed at a desired level in the secondary grades. Levin and others (Levin, 1988) have analyzed school programs and data on pupil progress

and have concluded that modifications are needed in schools to accelerate learning and skill development so that pupils can make satisfactory progress in the elementary grades and be able to continue to be successful in the secondary grades.

The Accelerated School Program emphasizes:

1. Establishing clear goals.
2. School-based management.
3. Modification of the curriculum to provide accelerated health and nutrition, social development, and personal development experiences and to include emphasis on academics.
4. Improving the quality of instruction by using effective instructional strategies and appropriate technology.
5. Providing high quality resources.
6. Making more effective use of regular and extended time.
7. Involving parents and the community.

The Comer Model - The School Development Program. Comer (1987) has developed a model for modification of elementary schools that has been implemented in several schools. The Martin Luther King Elementary School in New Haven, Connecticut, is one site that has implemented the model. The characteristics of the program include the following:

1. Strong parental participation.
2. Strong community involvement.
3. Strong commitment from school staff.
4. Local school management.
5. Emphasis on shared goals (values).
6. Use of effective instructional procedures.
7. Use of effective instructional materials.
8. Evaluation and modification of instruction and programs.

Evaluation of the Martin Luther King School indicates the program has been effective for helping at-risk pupils and that they have made good progress in mathematics.

Modification of middle schools. Middle schools are being increasingly viewed as a critical point for both the potential drop-out and the nominal mathematics student. Some middle schools have adopted programs and practices similar to effective schools criteria. Other practices being used include organizing to have schools-within-a-school to provide personal attention, use of the block of time (combining more periods to have one teacher spend more time with a pupil), team teaching, modifying tracking programs, and providing transition programs between elementary and middle schools, within middle schools, and between middle schools and high schools.

Transition programs are designed to help the pupil adjust from moving from one school to another, from one teacher to another, and from one grade to another. Transition programs are also designed to assist the teachers and counselors by providing information for them regarding the needs of new pupils.

The curriculum in mathematics is also being modified in middle schools. Changes are being recommended to provide experiences that will result in more positive student attitudes toward mathematics, make mathematics more relevant, emphasize major concepts, emphasize problem solving and other higher order learning skills, stress communication skills, and include desired content, such as probability and statistics, which has not been included or has been underestimated.

Middle schools need to check the progress of their former pupils as they progress through high school years to determine the effectiveness of their programs. Low enrollment and achievement in high school mathematics and high drop-out rates and low attendance rates in high school suggest both the middle school and the high school should examine their programs and the articulation and transition between their programs.

Instructional practices

Several instructional practices have been developed and implemented to improve achievement of potential at-risk and nominal mathematics pupils. Although some schools have used practices separately, many of the more effective programs have used combinations of these practices.

Cooperative learning. There are several approaches to cooperative learning practices. Among the models being used are those of (a) Slavin and others (1989), and (b) Johnson and Johnson (1986). Cooperative learning stresses using small groups to help each pupil learn and stresses cooperative effort and learning as opposed to competitive learning. One approach used in mathematics uses direct instruction by the teacher, followed by work in groups. Teammates check each others work regarding the concept or skill being learned and help other team members who need assistance. Check-up tests are frequently provided to help team members determine if they are ready for a quiz or test regarding the material. If pupils do not learn all the material, they are again assisted by team members.

Research data support the use of cooperative learning and indicate increased achievement, development of self-esteem, and development of communication skills. Cooperative learning can provide an effective alternative to tracking, especially in middle schools.

Continuous progress instruction. Continuous progress programs (Slavin & Medden, 1987) stress:

1. A specified hierarchy of knowledge and skills.
2. Assessment of knowledge and skills.
3. Instruction in groups, small groups, and by tutoring.

4. Assessment of progress.
5. Maintaining careful records of achievement and progress.
6. Assignment to special groups and materials for those who need more assistance.
7. Movement to new knowledge and skills when ready.

Continuous progress programs include grouping and regrouping based on progress of students and some individualized or programmed instruction as part of the regular program to provide for those pupils who need more or different instruction.

Diagnostic/prescriptive instruction. Diagnostic/prescriptive programs have many features in common with continuous progress instruction. Students are:

1. Pretested.
2. Assigned instructional materials and experiences.
3. Retested.
4. Assigned new materials or review materials based on need.

Records are maintained. The approach is frequently used on students with specific skill needs, rather than total programs.

Evaluation data suggest it has been more effective on computation and skill development than higher-order learning.

Accelerated learning. Accelerated learning programs (Kulik & Kulik, 1984) have been used as part of a school program as well as a total school program. The programs emphasize reducing unneeded repetition, inclusion of more content, reducing less important content, and increasing instructional efficiency.

One of the purposes of this approach is to help move pupils to grade level or beyond if they are behind. Proponents contend that many at-risk approaches do not help the pupil catch up to the appropriate grade level. A second purpose of accelerated learning programs is to focus on higher order thinking skills as well as lower-level skills.

Mastery learning. This learning strategy is designed to provide a sequence of materials and experiences that will help most of the students (usually about 80 percent) master the task assigned (Slavin & Madden, 1987). The strategy has been used successfully as a part of more complex programs or as a major learning approach in many schools.

The strategy usually involves:

1. Specifying objectives.
2. Specifying content and tasks.
3. Providing appropriate materials.
4. Providing appropriate activities.

5. Assigning manageable units of work.
6. Providing adequate time to master the skill.
7. Providing frequent evaluation.
8. Providing appropriate remediation.

Mastery learning approaches are frequently used in combination with continuous progress instruction and individualized instruction.

Individualized instruction. Individualized instruction has many of the features of continuous progress instruction but is based on the use of self-paced materials and usually relies heavily on programmed instruction or individualized materials. Many of the programs involve computer-assisted instruction and/or computer-managed instruction.

Companies such as WICAT, Jostens Learning Corporation, Computer Curriculum Corporation, and others have produced materials for this type of an approach.

Selected policies related to at-risk pupils

Although there are many policies that can affect at-risk pupils, a few have been found to be very important.

Grade retention. Promotion policies should be carefully reviewed. Alternatives to retention in grade should be developed and used whenever possible. Data indicate that students retained one grade are 40-50 percent more likely to drop out and students retained two grades are 90 percent more likely to drop out than other students. Students are more likely to stay in school if they are given special help and allowed to remain with their age group. Intensive help over a period of time tends to be more effective than retention.

Tracking. Children placed in academic tracks have tended to have higher mathematics achievement than students of equal ability placed in other tracks. Reasons for the differences are not totally clear, but several possible explanations are given:

1. Academic track students receive more exposure to knowledge and higher-order learning skills;
2. Students in academic tracks may have more access to materials and resources;
3. Peers in the academic tracks provide motivation that encourages achievement;
4. Students in academic tracks gain more self-esteem and develop higher educational aspirations; and
5. Students placed in academic tracks may be prepared from prior learning to achieve at a higher level.

Use of tracking is being debated. There are those who argue that tracking may need to be retained but that a higher percentage of the students should be placed in the academic tracks and that tracks should not determine student composition for all classes. Others argue that students should not be tracked so that students work with other students of all abilities. Cooperative learning approaches and differentiated assignments can be used to provide all students a rich learning environment, more positive peer influences, and improved self-esteem.

Inclass and pull-out programs. Both inclass and pull-out programs have been used for pupils requiring additional help in mathematics. Although the success of either program is based more on the quality of the program used and the instruction provided, inclass programs have tended to be more successful than pull-out programs.

Inclass programs have been most effective when they use continuous progress and cooperative learning procedures. Inclass programs tend to have less stigma attached to the program, provide better coordination with the regular curriculum, make more effective use of school time, and often result in less interference with other learning.

Pull-out programs are used at many sites for mathematics. The advantages of the inclass program are disadvantages for the pull-out program. Pull-out programs, however, often can provide a lower pupil-teacher ratio, more effective materials such as computer-assisted instruction, laboratory facilities, and a specialized teacher.

Class size. Class size has been found to be an important variable related to the achievement of at-risk pupils. Programs for young children (early elementary) have been more successful when classes have been small, frequently as low as 15 pupils. Larger class sizes for at-risk pupils that have been successful frequently have used approaches with substantial technology such as computer-assisted instruction or have used grouping techniques and peer or adult tutoring techniques.

Extending school time. A result of a number of international studies assessing mathematics achievement and variables related to achievement has been a consideration of the use of time during school hours and the analysis of use of time during out-of-school hours.

Techniques to extend school time include homework, extended daily sessions (after-school programs), Saturday School, summer schools, extended-year round programs, and year-round programs.

Effective use of homework has been found to be a significant variable in increasing learning for at-risk pupils as well as other pupils. When used effectively, homework is a low-cost way to extend the school day and to involve the family as well as the pupil in the school experience.

Extended daily sessions have been used effectively at some sites. It has provided an opportunity for pupils to get additional help and to explore other experiences. Some schools have used volunteers (adults) to assist with these programs. The programs also provide a place for "latch-key" children after school.

Saturday schools have been used effectively by some schools. Some of these programs have focused on mathematics. Reports indicate that they tend to be most successful when they focus on high-interest activities and provide experiences the pupils do not get during the regular school program. They can be effective as a way of developing more interest in subjects such as mathematics for nominal mathematics students and providing experiences that should be less threatening to underachieving students.

Summer schools have been used at a number of sites to increase learning time and reduce summer achievement loss. Data regarding summer schools for disadvantaged students are not consistent. Schools using high-interest summer experiences for elementary pupils in science and mathematics report positive impacts on interests, attitudes, and learning though relatively few well-structured studies are available.

Staff development. Research reports and surveys indicate that among the major reasons for students' difficulties in school are negative teacher-student interactions, negative feelings, and inappropriate instruction.

Implementing recommended policies via staff development programs is an effective approach for assisting at-risk pupils. The programs should focus on specific conditions desired and provide:

1. Models of the behaviors and practices desired.
2. Staff practice in using the models.
3. Feedback to staff on the effectiveness of the behaviors and practices,
4. Periodic evaluation.
5. Incentives and recognition for improvement.

Special services for at-risk pupils—counseling and health. At-risk pupils frequently have social, behavioral, and health needs in addition to academic needs. There is a growing trend to expand services to provide more help for at-risk pupils. Both the potential drop-out pupil and the nominal mathematics pupil can gain from these programs.

Research data indicate programs for both groups should be started in the elementary grades to promote prevention, rather than remediation. Pupils make many decisions early in their school lives that have a significant impact on later schooling.

How Can Parents and the Community be Involved to Prevent or to Reduce At-risk Problems Related to Mathematics Achievement?

There is a growing body of literature related to the importance of school and community involvement in school programs and the relationship of school success and success in later life. The at-risk literature identifies several home variables as both potential causes of at-risk conditions and also as potential solutions to at-risk problems.

Most effective school programs have included parent involvement in their programs. Parents can help a child's success by:

1. Understanding the school program and having reasonable expectations and goals.
2. Showing interest in the child's life, academic work, school activities, and future challenges and opportunities.
3. Encouraging regular school attendance.
4. Encouraging reading and writing.
5. Providing a place to study.
6. Providing materials for study.
7. Helping the child with time organization, including study time.
8. Monitoring homework in mathematics.
9. Listening to the child and discussing school activities with the child.
10. Working with the school by keeping communication lines open and knowing what is occurring at school.
11. Scheduling some "fun" activities on weekends and during vacations that relate to what the child has been studying in school and will be studying in school (including mathematics).
12. Beginning educational experiences early (prior to grade 1) with all types of learning including math skills.
13. Maintaining positive attitudes and behaviors toward learning and schooling.

Schools can provide several types of experiences and information that will help parents help their children. Communications can be sent home; meetings and workshops can be held; parent networks can be established; school visits can be arranged; and special programs can be developed for parents.

Among the successful programs for parents related to mathematics is FAMILY MATH. FAMILY MATH provides a series of experiences for parents and children (elementary and middle school grades). The activities are designed to motivate pupils to enjoy mathematics, continue to study mathematics, and to gain parental understanding and support. See Section VII for more information on this program.

The Mathematical Association of America (MAA) and the National Council of Teachers of Mathematics (NCTM) have also cooperated to develop some guidelines for parents indicating how they can help their children to learn mathematics. A free copy can be obtained from MAA (See Section VI for their address).

Because at-risk problems are often related to community problems, there is a trend to develop community support to help reduce at-risk problems and to assist at-risk children. These efforts have most frequently been established in minority and low socioeconomic areas.

Effective community programs frequently have several characteristics in common they:

1. Involve all aspects of the community, including businesses, community leaders, and parents;
2. Frequently have special programs for target (special populations);
3. Have a variety of schedules, sites, and programs for students;
4. Have commitment from community leaders and school personnel to cooperate and learn together; and
5. Begin programs in elementary grades and continue through high school.

Several of the regional educational laboratories have been involved with these programs or have published reports regarding these community groups. The regional educational laboratories are listed in Section VIII of this publication.

IV. WHAT ARE CLASSROOM PRACTICES THAT PREVENT OR TO REDUCE AT-RISK PROBLEMS RELATED TO MATHEMATICS ACHIEVEMENT?

Data indicate a strong relationship exists between early mathematics achievement, experiencing success in mathematics, a positive self-image and later mathematics achievement. Mathematics competency is learned and positive attitudes toward mathematics are also learned. Mathematics instruction that is planned and conducted to ensure success tends to produce fewer remedial pupils and fewer nominal mathematics pupils. Prevention is more successful than remediation and early remediation is more successful than attempts at later remediation.

Although more research is needed to develop better models, a variety of important variables related to positive mathematics achievement and to positive attitudes toward mathematics have been identified. Practices that help to provide these variables have also been identified.

This section of the monograph focuses on several variables related to at-risk students and presents practices that have been found to be effective.

Instructional and Management Practices to Develop and Improve Pupil Attitudes Toward Mathematics

Research data indicate a variety of practices have helped to make pupils successful in mathematics. Included are:

1. Providing clear goals and objectives.
2. Providing adequate time for mathematics instruction.
3. Using a variety of instructional approaches to accommodate learning styles, preferences, and needs.
4. Providing for the developmental levels of the pupils.
5. Using continuous progress approaches.
6. Using cooperative learning approaches.
7. Stressing effective use of homework.
8. Using a diagnostic and prescriptive approach in instruction to help identify pupil errors and to keep them from falling behind grade level expectations.
9. Using early identification and intervention procedures for pupils with learning problems.
10. Using frequent monitoring to identify pupils with possible problems.
11. Maintaining careful records of pupil progress.
12. Frequently using inclass procedures and special assistance (tutoring) to help pupils who have had difficulty in mathematics.
13. Providing intensive individual attention to individuals with sustained problems for a period of time.

14. Providing transition for incoming pupils and transition for pupils promoted to the next grade;
15. Providing instruction in learning how to learn including study skills, goal setting, and taking tests;
16. Using an activity-learning approach;
17. Using technology, such as calculators to help pupils be able to spend more time on problem solving and use of skills;
18. Using praise frequently;
19. Displaying good pupil work;
20. Integrating mathematics with other subjects;
21. Being alert to those who have poor attendance records and providing help to ensure learning and to correct the attendance problem;
22. Providing time on task (more time on instruction); and
23. Providing instruction to help pupils on perceptual and cognitive processing problems (such as memory, attention, spatial, reasoning).

These instructional practices and management practices can be used by classroom teachers in combination with an effective curriculum and instructional materials to help pupils progress at a desired rate and to help those in need of remediation. Section V provides descriptions of programs and materials that incorporate many of these practices; using these programs or some similar program will facilitate modifying instruction.

Self-confidence related to mathematics

Mathematics confidence has frequently been found to relate significantly to mathematics achievement and to enrollment in elective mathematics courses in secondary schools and higher education . Many at-risk students have been found to lack confidence in their mathematical abilities.

Some important practices for helping students to develop confidence are:

1. Providing success in mathematics and continuing success as early as possible.
2. Helping students who have not been successful to become successful.
3. Making students aware that the teacher knows they are being successful and is proud of what they are doing.
4. Taking action to correct student misunderstandings and lack of skills on a regular basis.

Future goals and expectations

Pupils who have goals for the future, who desire to be academically successful, who have a positive feeling about their mathematical ability, and who realize that effort is frequently needed for success generally achieve better than

students who do not. Teachers need to use classroom practices that help to develop these attitudes.

Practices should be used that:

1. Focus on goal-setting and the relationship of early experiences to future options, opportunities, choices, and success.
2. Stress the value of education in general and mathematics education in particular.
3. Help pupils to realize that mathematical success is learned.
4. Goals, and expectations are achieved through effort.
5. Everyone has setbacks, and must reassess the problem and learn needed knowledge and skills.

Some practices that have been effective include:

1. Using activities that focus on setting goals, the value of education, the value of mathematics, and the importance of experiences and achievement for later options and choices.
2. Bringing in speakers who can serve as role models (successful adults, successful older students) for the target group of pupils.
3. Providing praise when pupils master some new or harder work.
4. Providing praise and recognition when pupils expend effort and are successful on difficult work.
5. Requiring students to set goals and expectations and maintain records to monitor progress.
6. Providing activities that indicate careers using mathematics are filled by adults from the target pupil group (women, minorities, etc.).

Study skills, effort, persistence

Pupils who have positive attitudes toward studying, persisting in the face of difficulty, and expending effort for success are generally more successful than pupils who do not exhibit these traits. Although attitudes change over time, teachers and counselors report a high correlation between early attitudes and behavior patterns and later attitudes and behavior patterns. Changing negative attitudes and habits often becomes more difficult as the child becomes older.

Practices should be used that:

1. Focus on the need for study skills for success.
2. Provide instruction on effective study sills.
3. Focus on the need for effort and persistence.
4. Emphasize that difficulties can be overcome by effort but may require time.

Practices that have been effective include:

1. Providing direct instruction on study skills related to mathematics.
2. Working with parents to have them assist pupils by providing study space, time for study, and monitoring study.
3. Providing praise and recognition for effort.
4. Providing both short-term and longer-term assignments to help pupils learn how to do them.
5. Providing appropriate level problems but also providing problems with increasing difficulty.
6. Bringing in appropriate role models for the target of students.
7. Monitoring progress and providing feedback and direction on these skills, attitudes, and habits.

Positive teacher/pupil relationships

Surveys of students who drop out indicate that usually more than 25 percent of the students report that they did not have good relationships with their teachers. Developing classroom environments that encourage the student to come to school and to want to learn is an important variable in helping the at-risk pupil.

Desirable practices include:

1. Showing personal interest in the pupil on a consistent basis.
2. Providing experiences that enable pupils to be successful.
3. Maintaining a fair classroom environment for discipline.
4. Assisting pupils with school and out-of-school problems.
5. Helping pupils with transition from class to class, grade to grade, and school to school.
6. Being patient with students.
7. Being friendly.
8. Establishing contact with the student's family.

Developing positive interests for mathematics and the use of mathematics

Pupils in the elementary grades usually report a positive interest in mathematics. However, studies show that after grade 6, a reduction in student interest in mathematics and liking mathematics frequently occurs. Some of the reasons for the reduction in positive attitudes are:

1. Lack of success in mathematics.
2. The feeling that mathematics activities are not fun.
3. Lack of relevance of the mathematics curriculum and instruction to the pupil's every day life.

4. Lack of relevance of the curriculum and instruction to anticipated careers.
5. The feeling that mathematics requires more work than some other studies.

Although some successful students have negative attitudes toward mathematics, a high percentage of unsuccessful students have negative attitudes. If these attitudes are maintained, the individual affects not only his/her own behavior, but also that of peers. Efforts should be made to make learning mathematics more interesting and fun, and efforts should be made to demonstrate the usefulness of mathematics in everyday life and in careers.

Practices that have helped make learning more fun include:

1. Using a variety of approaches for teaching mathematics.
2. Providing activity-based experiences.
3. Using calculators and other technology to provide effective instruction and to reduce unneeded drill and practice.
4. Providing real experiences (such as field trips) in which mathematics is used.
5. Applying mathematics to everyday life.
6. Providing puzzles and games for those interested in using them.
7. Helping pupils to be successful and to progress in developing their skills.

A variety of practices has been used to develop positive interests related to the usefulness of mathematics. Regular school programs include emphasis on:

1. Mathematics in everyday life.
2. Mathematics as it relates to potential careers.
3. The value of learning mathematics in terms of personal living and job related opportunities.

Many schools are also providing special programs for girls and minorities. Schools report these interventions are successful when comprehensive and provided over a period of time.

V. WHAT ARE SOME PROGRAMS AND MATERIALS THAT CAN PREVENT OR TO REDUCE AT-RISK PROBLEMS RELATED TO MATHEMATICS ACHIEVEMENT?

There are a variety of programs and materials that have been found to be effective for improving students' mathematics achievement and their attitudes toward school and mathematics, and for encouraging them to enroll in more mathematics courses. This section lists a selected sample of programs, publications, and software that have been reported to be effective.

Programs and Materials Included in the National Diffusion Network

Some programs have been reviewed by the National Diffusion Network (NDN) sponsored by the U.S. Department of Education. The NDN provides funds to disseminate exemplary programs and materials. Before a program can be included in the NDN program, it must be approved by a review group, the Program Effectiveness Panel. A program requesting a review must provide evaluation data that indicate the program was effective in the school in which it was developed or field tested and that it could be used successfully in other schools. Programs or materials that are judged effective are summarized in the Department of Education publication Education Programs that Work (Education Programs..., 1988); updated editions are produced periodically.

1. Programs and Materials for Grades 1-6+

   a) Title: Astra's Magic Math
   Audience:
   Kindergarten
   Description:
   A 22-unit success-oriented beginning math program employing an organized oral language-based, multisensory approach using techniques for a foundation of any math system cr program. Available in English and Spanish.
   Comments:
   Has been evaluated for effectiveness with students and included in NDN.
   Contact:
   Jeanne Stout Burke, Judith Brown, or Gretchen Ross
   Co-Directors, Co-Developers
   Astra's Magic Math
   Sunshine Gardens School
   1200 Miller Ave.
   South San Francisco, CA 94080
   (415) 588-8082

b) Title: Comprehensive School Mathematics Program
Audience:
Grades K-6
Description:
Material is presented as an extension of experiences children have encountered in real-life and in fantasy. Children are led through sequences of problem-solving and experiences presented in game-like and story settings. The content is sequenced in spiral form.

A variety of tools such as hand-held calculators and geometry tools are used.

Underlying assumptions of the CSMP curriculum are that children should enjoy learning math and that math should be taught and learned as a unified whole.

Comments:
Has been evaluated for effectiveness with students and included in NDN.

Contact:
Clare Heidema, Director
CSMP
12500 E. Iliff Ave.
Suite 201
Aurora, CO 80014
(303) 337-0990

c) Title: Mathematics Achievement Program (MAP)
Audience:
Grades 2-5
Description:
This is a pull-out remedial mathematics program. To help students overcome difficulties in computation concepts and application skills, eligible students are scheduled into centers and provided instruction through a diagnostic/prescriptive system. Using a composite analysis of several criterion-referenced achievement tests, an individual math profile is developed for each student. Behavioral objectives are used to formulate a prescription to meet the interests and needs of each pupil. Thirty-minute instructional sessions are conducted in small groups; teacher-pupil ratio 6/1.

Comments:
Has been evaluated for effectiveness with students and included in NDN.

Contact:

John W. Williams
Federal Project/Perry Building
9 Fulton Street
Chester, PA 19013
(215) 447-3860

d) Title: Title I Mathematics Computer Assisted Instruction (CAI)

Audience:

Grades 3-6

Description:

In order to increase growth in mathematics, computer-assisted instruction was added to an already effective math program. The program is operated with close coordination of math-lab instruction and daily CAI drill. The CAI program adjusts instructions to the level of the students and provides immediate feedback to the student. The CAI program provides daily, weekly, and monthly descriptions of progress and areas of difficulty which the classroom teacher can use to correct specific conceptual misunderstandings.

Comments:

Has been evaluated for effectiveness with students and included in NDN.

Contact:

Mr. John Martin, Supervisor
Federally Support Programs
Lafayette Parish School Board
P.O. Drawer 2158
Lafayette, LA 70502
(318) 236-6800

e) Title: Classmate 88 Mathematic Computations Skills Program

Audience:

Grades 4-6

Description:

A pullout program incorporating technology to improve the basic mathematical skills of economically disadvantaged children. The program uses a programmed math machine known as the Classmate 88. The machine includes 70 programs.

Comments:

Has been evaluated for effectiveness with students and included in NDN.

Contact:

Janice M. Putz
Chapter I Department
South Bend Community School Corporation
635 South Main Street
South Bend, IN 46601
(219) 282-4181

f) Title: Diagnostic Prescriptive Arithmetic (DPA)
Audience:

Grades 1-6

Description:

DPA is a process-oriented program emphasizing the development and refinement of teacher modeling and questioning skills. DPA includes counting, place value, addition, subtraction, multiplication, and division of whole numbers. Problem-solving skills are developed and reinforced through ongoing experiences with estimation and approximation, data collection, organization and interpretation, and real-life applications of arithmetic skills. Diagnostic tests for the major arithmetic topics (three levels) are used throughout the year to determine students' strengths and weaknesses both in concepts and skills. Prescriptions are then planned using the DPA Teacher's Manual, manual supplement, and other DPA resource materials.

DPA can be used in self-contained elementary grade classes as the arithmetic component of the mathematics program or as a co-curricula remediation program that uses manipulative and physical materials and is adaptable to special education students.

Comments:

Has been evaluated for effectiveness with students and included in NDN.

Contact:

Josephine Ceiling
Community School District #31
211 Daniel Low Terr
Staten Island, NY 10301
(718) 447-3300, ext. 36, 37

g) Title: Individualized Prescriptive Arithmetic Skills System (IPASS)
Audience:

Grades 5 and 6

Description:

This is a pull-out program but can be adapted to a classroom or laboratory setting. IPASS was designed to increase the

achievement of intermediate grade students in mathematics through the use of advanced technology in the form of microcomputers. IPASS employs microcomputers and specially designed software as an integral part of both instruction and the management of student progress in a compensatory education setting.

IPASS includes criterion-referenced tests, instructional and management software, cross-referenced tests, cross-referenced instructional resource file, and guides for teachers and students. IPASS objectives can be used to supplement most mathematics curricula without modification.

IPASS is designed as a "pull-out" program in which the student receives two 30-minute sessions per week. IPASS can be adapted to a classroom or laboratory setting.

Comments:

Has been evaluated for effectiveness with students and included in NDN.

Contact:

Henry Cole, Director
Karen McCluskie, Ch. I Coordinator
Project IPASS
Pawtucket School Department
Park Place
Pawtucket, RI 02860
(401) 728-2120

h) Title: Systematic Teaching and Measuring Mathematics (STAMM)

Audience:

Grades K-8

Description:

The major objective of this program is to provide continuous progress in mathematics for the entire school experience of all students.

The STAMM program represents a complete system that can be adopted or adapted by other districts. A framework of objectives and assessment by criterion-referenced tests are basic to STAMM. The basic skills continuum for grades K-8 is covered in levels A, B, C, D, E, F, GE, G, and H. Special materials are packaged for Chapter I, gifted/talented, and special education. Additional materials are available for secondary courses for college preparatory, general and remedial math students, namely in sequences of Algebra I-Calculus, Consumer Statistics-Informal Geometry, and Math Competency-Applied Math, respectively.

The program may be used successfully in many different classroom situations, including small-group instruction, large-group instruction, individualized instruction, team teaching, and math labs. Resource material is provided for each objective; textbooks, manipulative materials, and teacher-made resources may be incorporated as well.

Comments:

Has been evaluated for effectiveness with students and included in NDN.

Contact:

Sherry Stumbaugh, STAMM Project Director
Jefferson County Schools
1005 Wadsworth Boulevard
Lakewood, CO 80215
(303) 231-2381

i) Title: Team Accelerated Instruction: Mathematics

Audience:

Grades 3-6

Description:

Team Accelerated Instruction (TAI Math) is a program that helps teachers to meet the diversity of student needs within the math class. It combines quality interactive instruction with the power of cooperative learning to:

- Accelerate the achievement of all students
- Maximize teaching and learning time
- Enhance student motivation and attitudes toward math
- Improve students' social interaction

Students receive concept instructions from the teacher in small homogeneous teaching groups. They then practice the skills learned in 4 to 5 member heterogeneous learning teams at their own pace on materials appropriate to their specific needs.

TAI Math instruction is organized into 13 paperbound non-consumable student skill books. Each classroom set of books contains skills ranging from advanced addition to pre-algebra.

Comments:

Has been evaluated for effectiveness with students and included in NDN.

Contact:

Barbara Luebbe, Project Director
Dissemination and Training Coordinator
Johns Hopkins University
Center for Social Organization of Schools
3505 N. Charles St.
Baltimore, MD 21218
(301) 338-8249

j) Title: Help One Student to Succeed (HOSTS Math)

Audience:

Grades K-8

Description:

HOSTS Math is a self-contained program which includes a diagnostic/prescriptive component which accurately places students in a precise sequence of math skills. Each student moves from one skill to the next as mastery is demonstrated. Teachers are provided with lesson plans for each skill which are designed to build a conceptual understanding before proceeding to the symbolic level of drill and practice. Material is offered in manageable segments with attainable goals for students.

Complete lesson plans, student worksheets, tests, and answer sheets are provided for paper and pencil work covering 18 strands. Fourteen computer disks, designed for Apple computers are included for drill and practice an well as testing, along with a class management component and record keeping capability. The program specifies the use of manipulatives for each objective to provide the instructor with several options to encourage mental math, problem solving and development of higher order thinking skills.

The program has been used successfully in pull- out, special education, replacement, and classroom supplement models using one-on-one tutoring or small group instruction.

Comments:

Has been evaluated for effectiveness with students and included in NDN.

Contact:

Carol Jacobsen, Math Support Representative
1801 D Street
Suite 2
Vancouver, WA 98663
(206) 694-1705

k) Title: First Level Mathematics (KINDERMATH)
Audience:
Grades K-1
Description:
This program is diagnostic/prescriptive in nature, providing a sequential curriculum for individual developmental growth. The 90 lesson curriculum consists of the following nine components: same and different; patterns; sets zero to five; shapes; sets six to ten; numerals six to ten; signs; and addition/subtraction. Key elements of the program are developmental hierarchies, mixed instructional modes, low child-teacher ratio, and extended curriculum range.

The program has been designed to be used by both regular and special education teachers. Because it is available in Spanish, it is also appropriate for use in bilingual and ESL programs.

The entire program is also available for the computer. The 13 disk system is tutorial in nature, uses a voice synthesizer, and may be used without the assistance of the teacher.
Comments:
Has been evaluated for effectiveness with students and included in NDN.
Contact:
Ms. Mary Alice Felleisen
38 North Waterloo Road
Devon, PA 19333
(215) 688-7993

l) Title: Success Understanding Mathematics (SUM)
Audience:
Grades 1-6
Description:
The program was designed to increase the level of mathematics achievement of children who were achieving below the level expected. The project materials and teaching techniques are appropriate, however, with students of all ability levels. Direct instruction is emphasized to facilitate student interaction in their development of concepts. Teaching strategies described in project manuals are based on Jean Piaget's research about the way children learn mathematics, specifically elementary school children's difficulty with abstract thought and their consequent need for concrete materials. Computational algorithms are developed through objects to solve problems Drill follows understanding.

Criterion-referenced tests for the objectives and record keeping materials are available.

Comments:

Has been evaluated for effectiveness with students and included in NDN.

Contact:

Kathleen Bullington, Project Director
Success Understanding Mathematics
Des Moines Public Schools
Rm. 113, 2430 East University
Des Moines, IA 50317
(515) 265-4554

m) Title: Conceptually Oriented Mathematics Program (COMP)

Audience:

Grades 1-8

Description:

This program provides sequential mastery skills with corresponding instructional materials to be mastered in the basic skills area of mathematics. It is designed to meet individual needs through small-group instruction.

Students are tested to determine their individual strengths and weaknesses and are grouped accordingly. The program provides continuous progress through the use of materials organized into 25 instructional levels. Nine strands are developed for mastery in these 25 levels. Critical thinking skills are developed throughout the 25 levels. All COMP math objectives are correlated to major math textbooks. Correlations are included in the COMP Guidebooks.

The program uses cooperative planning and teaching. The ideal instructional situation is one in which each teacher has no more than two instructional groups. It is the intent of the program to encourage teachers to be creative in their teaching and to adapt the program to the learning styles of their students.

Comments:

Has been evaluated for effectiveness with students and included in NDN.

Contact:

Leon Webb, Special Facilitator Assistant
Director
161 E. First Street
Suite 5
Mesa, AZ 85201
(602) 969-4880

n) Title: MICRO/MATH
Audience:
Grades 6-8
Description:
This is a problem-solving program that focuses on problem solving, computational skills, and the use of computers and mathematics related to work. It is a supplementary program.
Students use 35-40 worksheets with and without microcomputers for about 20 percent of the math time.
Comments:
Has been evaluated for effectiveness with students and included in NDN.
Contact:
Dr. Dean Nafziger
Education Research and Development
Far West Laboratory
730 Harrison Street
San Francisco, CA 94107
(415) 565-3000

2. Programs and Materials for Grades 7 and Up (Also See Programs in the Previous Section that Included Grades 1-6+)

a) Title: Competency Based Program for Mathematics Mastery
Audience:
Grades 7 & 8
Description:
This program incorporates a prescriptive learning competency based instructional approach. A battery of tests has been developed for diagnostic and error pattern analysis, placement, and mastery. A variety of games, puzzles, and manipulatives have been developed for the program.
Comments:
Has been evaluated for effectiveness with students and included in NDN.
Contact:
Linda Shibley, Director
Southeast Junior High
Rt. 3
2001 Ohio Street
Pine Bluff, AR 71601
(501) 543-4350

b) Title: Decision-Making Math (DMM)
Audience:
Grades 7, 8, and 9

Description:

DMM encourages students to be more comfortable and capable when solving problems by putting mathematics in the context of situations they might face in real life. DMM is a supplement to the regular math program and uses student guides, worksheets, strategy cards, home activities, and problems of the week developed especially by this program. Specifically, DMM teaches students to: analyze problems and select strategies for solutions, and apply problem-solving skills to everyday situations. Students are encouraged to solve problems independently, with classmates, and with family members.

Comments:

Has been evaluated for effectiveness with students and included in NDN.

Contact:

Laura Dunn and Kristine Shaff, Co-Directors
Education and Technology Foundation
4655 25th Street
San Francisco, CA 94114
(415) 824-5911

c) Title: Project DPI

Audience:

Grades 7-9

Description:

The DPI curriculum is a diagnostic, prescriptive, individualized curriculum that consists of 23 "advancement tracks" or levels which encompass key learning areas in arithmetic, pre-algebra, algebra, and geometry. For each track - or continuum - a sequential set of about 15 study packets (daily lessons) is available. Results of a criterion-referenced pretest are the basis on which teachers diagnose each student's strengths and weaknesses to determine placement of that student in the appropriate study packet and track.

Comments:

Has been evaluated for effectiveness with students and included in NDN.

Contact:

Roger W. Shickler, Project Director
Project DPI
Long Beach Unified School District
Franklin Junior High School
540 Cerritos Ave.
Long Beach, CA 90802
(213) 436-9931

d) Title: Math Motivational Centers (M2C)
Audience:
Grade 9
Description:
This is a pull-out program that provides intensive remedial instruction. In each Math

Center, which is set up to be operated separately from the math classrooms, are located state-of-the-art materials for instruction in basic math skills. The M2C instructional management system provides for diagnosis, through criterion-referenced pretests, of each student's strengths and weaknesses in specific skills. Prescriptions guide the teacher and students to appropriate learning materials which are available in several modes. The management system has been designed to increase actual time on task to the maximum possible in each class period. Mastery of each instructional unit is measured by criterion-referenced posttests. A simplified record keeping system is used to document each student's progress through his or her own curriculum path. The component skills of mathematics have been tagged with 239 separate learning tasks and a series of matched math action applications.

Comments:
Has been evaluated for effectiveness with students and included in NDN.

Contact:
Carolyn Rosenfield and Raymond Senes
105 Main Street
Norwalk, CT 06852
(203) 847-0481, ext. 266 and 258

A Selection of Other Programs and Materials

1. Programs and Materials for Grades 1-6+

a) Title: Solve It
Audience:
Intermediate Grades
Description:
This is a supplemental set of materials containing 18 15-minute television programs. Programs focus on problem solving and include emphasis on estimation, mental computation, ratios, measurement, statistics, fractions, decimals and geometry. Materials are recommended for use at the grade 6 level.

Comments:

Has received several program awards and positive reviews as a supplemental program.

Contact:

Agency for Instructional Technology
P.O. Box A
Bloomington, IN 47402

b) Title: Counterplot

Audience:

Intermediate Grades

Description:

This is a supplemental set of materials containing 16 20-minute television programs. Programs focus on specific mathematics skills and a step-by-step approach to problem solving. Uses a humorous story of a detective to help interest students in numbers, fractions, percents, formulas, decimals, and money problems.

Comments:

Received an award for the teacher's guide and positive reviews as a supplemental program.

Contact:

Maryland ITV Publications
11767 Owings Mills Avenue
Owings Mills, MD 21117
(301) 581-4207

c) Title: Math Works

Audience:

Intermediate Grades

Description:

This is a supplemental set of materials containing 28 15-minute television programs. The goal of this series is to help students understand mathematical ideas and to use them to solve problems. Focuses on estimation, mental computation, and problem solving applied to real-life problems. Content includes geometry, decimals, fractions, measurement, statistics, and ratios.

Comments:

Has received several awards for specific program and positive reviews as a supplemental program.

Contact:

Agency for Instructional Technology
P.O. Box A
Bloomington, IN 47402
(812) 339-2203

d) Title: Figure Out
Audience:
Intermediate Grades
Description:
This is a supplemental set of materials containing fifteen 15-minute television programs. The programs concentrate on mathematics problems usually encountered in grades 5 and 6, including place value, estimating, rounding, addition and subtraction of hundreds, and multiplication and division. Uses an adventure story to create interest.
Comments:
Has received several program awards and positive reviews as a supplemental program.
Contact:
Agency for Instructional Technology
P.O. Box A
Bloomington, IN 47402
(812) 339-2203

e) Title: Middle Grades Mathematics Project
Audience:
Grades 6, 7, and 8
Description:
Includes curriculum units that are taught using an instructional model based on three phases: launching, exploring, and summarizing. A strong emphasis is placed on inservice education to assist teachers to promote more effective teaching.
Comments:
Units have been reported to be effective in improving student interest and achievement.
Contact:
William Fitzgerald
Middle Grades mathematics Project
Michigan State University
Mathematics Department
East Lansing, MI 48829

f) Title: Project Catch-Up
Audience:
Grades K-12
Program:
This is a continuous diagnostic mathematics program designed for underachieving students. It can be adapted into any existing mathematics program.

Students spend an average of one-half hour per day in a laboratory. They work with a laboratory teacher individually or in small groups on skill deficiencies. Diagnostic testing is used to identify skill deficiencies.

Comments:

Students have demonstrated improved attitudes toward mathematics, increased self-confidence, and improved classroom performance in mathematics.

Contact:

Fay Harbison
Project Catch-Up
P.O. Box 2506
Newport Beach, CA 92663
(714) 548-4240

g) Title: Family Math

Audience:

Parents and pupils K-8

Description:

A typical course includes six or eight sessions involving parents and children in opportunities to develop problem-solving skills and to develop some understanding of mathematics through hands-on activity.

Comments:

Has been successful in developing interest and motivation for students in relation to mathematics.

Contact:

FAMILY MATH
Lawrence Hall of Science
University of California
Berkeley, CA 94720
(415) 642-1823

h) Title: EQUALS

Audience:

Grades K-12

Description:

This program is designed to encourage women and minorities to continue participation in mathematics and science courses throughout their formal education, increase their confidence and competence in mathematics and science and observe the usefulness of mathematics and science to potential careers.

Involves a variety of activities and incorporates role-models including women and minorities.

Comments:

Has been reported to be successful in increasing interest of girls and minorities in mathematics and science.

Contact:

EQUALS
Lawrence Hall of Science
University of California
Berkeley, CA 94720
(415) 642-1823

2. Programs and materials for Grades 7 and Up (also see programs in the previous section that included Grades 1-6+)

a) Title: University of Chicago School Mathematics Project

Audience:

Grades 7-8

Description:

The program emphasizes reading, using calculators and computers, performing applications, and exploring topics including statistics, probability, algebra and geometry. Students meet daily in classes.

Comments:

Has been shown to improve student achievement and attitudes. The University of Chicago School Mathematics Project is developing a total K-12 program.

Contact:

University of Chicago School Mathematics Program
Department of Education
University of Chicago
5838 S. Kimbark Ave.
Chicago, IL
(312) 702-1559

Computer Instructional Systems and Computer Software

There are several computer instructional systems that have been used to provide success for potential at-risk pupils and for at-risk pupils.

Systems are available from Wasatch Education Systems, WICAT, Jostens Learning Corporation, Computer Curriculum Corporation, and others. Software is available from many sources including the Learning Company, Minnesota Educational Computing Consortium, Sunburst Communication, and Mindscape Educational Software.

Reviews of software are available for purchase from the Northwest Educational Laboratory, and Educational Products Information Exchange (EPIE).

Compilations of software reviews are produced by the Bowker Company and the Gale Research Corporation and available in many large libraries.

VI. WHAT SHOULD YOUR SCHOOL DO? WHAT SHOULD YOU DO?

There are clearly two levels of action that should be taken:

1. The total school staff (and others) should review the school program and its impact on pupils.
2. Individuals should review classroom and support programs for which they are responsible and the impact of these on pupils.

School Level Assessment and Program Modification

Based on the outcome of the study, a variety of actions might be taken:

1. School restructuring.
2. Curriculum modification.
3. Changes in the instructional program.
4. Changes in instructional materials.
5. Changes in support services.
6. Changes in programs involving parents and the community.

If your school has a high percentage of potential dropouts, some of the school restructuring programs such as those suggested by effective schools research, Slavin, Comer, and Levin should be considered. These programs include a variety of the variables associated with the reduction of at-risk problems and have demonstrated success. In addition to the school restructuring emphasis, the mathematics curriculum should be carefully analyzed using guidelines such as those of the NCTM Standards and others. Instructional approaches should also be reviewed to determine if different instructional strategies (such as cooperative learning, tutoring, mastery, etc.) different materials and the use of technology (calculators, computers) could improve the effectiveness and efficiency of the program.

School staff should visit sites using a program, instructional strategies, materials, or technology that you are considering. Your staff can observe the use of the approach and talk with staff, pupils, and parents. If you decide to implement or adapt a program or practice, it is frequently cost-effective and less frustrating to consult with personnel from a school that has had previous experience to assist your school in planning for implementation. They can help you plan for needed staff development, material purchases, evaluation procedures, phasing in the program, and planning for possible maintenance and institutionalization.

The Regional Laboratory for Educational Improvement of the Northeast and Islands has produced a useful *Action Guide to School Improvement.* The publication provides suggestions for a school action plan.

Since most at-risk difficulties are due to multiple causes, school-wide programs are normally more effective than efforts of any one teacher or program. However, starting to make desired changes often depends on someone showing interest and becoming involved.

Classroom and program modification

Individual teachers can also make an impact on the at-risk pupil and can help to establish interest in school-based programs.

This monograph provides suggestions for various types of practices and materials that can be used by the individual classroom teacher. As with school-based changes, visiting a school where the practices and/or materials have been used is desirable. Personnel involved in some of the programs described in this monograph recommended trying to have at least one other teacher in your school building involved in similar activity with at-risk pupils; they believe the "buddy system" provides a supportive mechanism for sharing ideas for making changes, trying to make changes, and working with pupils, staff, and parents.

Making Contacts for Ideas and Assistance

Section VII of this monograph provides lists of resources and Section VIII contains references that should be helpful for obtaining ideas, advice, and assistance.

Every state has National Diffusion Network (NDN) Facilitators (people that work with NDN and that are located in each state). NDN Facilitators are able to help a teacher or school staff identify materials and programs that are available and to help the school staff make contact with the developers of the materials and/or sites using the materials.

The Regional Education Laboratories are excellent sources of information and assistance. The laboratories are listed in Section VIII. You can contact them for assistance.

State mathematics specialists or coordinators can also provide assistance. They can be located by contacting the state department of education for your state.

An excellent way of making contacts for ideas and assistance is to attend national and regional conferences of the National Council of Teachers of Mathematics (NCTM). Every recent conference of NCTM has had people presenting ideas and materials related to pupils at-risk in mathematics.

VII. SELECTED RESOURCES FOR INFORMATION RELATED TO AT-RISK STUDENTS

Agency for Instructional Technology
P.O. Box A
Bloomington, IN 47402
(812) 339-2203

Appalacia Educational Laboratory, Inc. (AEL)
1031 Quarrier Street
P.O. Box 1348

Chapter 1 Technical Assistance Center Clearinghouse
Advanced Technology
2601 Fortune Circle East, Suite 300A
Indianapolis, IN 46241
(317) 244-8160
(800) 456-2380

Children's Defense Fund
122 "C" Street, NW
Washington, DC 20001
(202) 628-8787

Computer Curriculum Corporation
P.O. Box 3711
Sunnyvale, CA 74088-3711
(408) 745-6270

Council of Chief State School Officers
379 Hall of States
400 North Capitol Street, NW
Washington, DC 20005
(202) 371-0163

Dade County Public Schools
Division of Droput Prevention
1540 NE Second Avenue
Miami, FL 33132

Far West Laboratory for Educational
Research and Development (FWL)
1855 Folsom Street
San Francisco, CA 94103

Jostens Learning Corporation
6170 Cornerstone Court East
Suite 300
San Diego, CA 92121
(800) 521-8538
(800) 221-7927

The Learning Company
6493 Kaiser Drive
Fremont, CA 94555
(415) 792-2101

Martin Luther King Elementary School
580 Dixwell Avenue
New Haven, CT 06511
(203) 787-8666

Mid-Continent Regional Educational Laboratory (McREL)
12500 East Lliff, Suite 201
Aurora, CO 80014
and
4709 Belleview Avenue
Kansas City, MO 64112

Minnesota Educational Computing Consortium (MECC)
3490 Lexington Avenue
St. Paul, MN 55126
(612) 481-3500

National Council of Teachers of Mathematics
1906 Association Drive
Reston, VA 22091
(703) 620-9840

National Diffusion Network Program
Office of Educational Research and Improvement
U.S. Department of Education
555 New Jersey Avenue, NW
Washington, DC 20208-5530
(202) 219-2134

National Dropout Prevention Center
Clemson University
205 Martin Street
Clemson, SC 29634
(800) 443-6392

National Dropout Prevention Network
1517 "L" Street
Sacramento, CA 95814
(916) 342-3639

North Central Regional Educational Laboratory (NCREL)
295 Emroy Avenue
Elmhurst, IL 60126

Northwest Regional Educational Laboratory (NWREL)
101 S.W. Main Street, Suite 500
Portland, OR 97204

Pittsburgh Public Schools
Public Information Officer
341 South Bellefield Avenue
Pittsburgh, PA 15213
(412) 622-3500

Regional Laboratory of Educational Improvement
of the Northeast and Islands
290 South Main Street
Andover, MA 01810

Research for Better Schools
444 North Third Street
Philadelphia, PA 19123

Southeastern Educational Improvement Laboratory (SEIL)
P.O. Box 12748
200 Park Offices, Suite 200
Research Triangle Park, NC 27709

Southwest Educational Development Laboratory (SEDL)
211 East Seventh Street
Austin, TX 78701

Sunburst Communication
101 Castleton Street
Pleasantville, NY 10520
(914) 769-5030

Wasatch Education Systems
5250 South 300 West
Suite 350
Salt Lake City, UT 84107

WICAT
1875 S. State Street
Orem, UT 84058
(800) 759-4228

VIII. References

References identified with an ED number have been abstracted for the Educational Resources Information Center (ERIC) and are in the ERIC database. The database can be accessed online, via CD-ROM, and through the use of paper indices. Most documents having an ED number are available in ERIC microfiche collections at over 1,000 locations worldwide. Documents can also be ordered through the ERIC Document Reproduction Service (EDRS): 1-800-433-ERIC. For more information about the ERIC system, contact ACCESS ERIC (1-800-LET-ERIC). For more information regarding the products and services of the ERIC Clearinghouse for Science, Mathematics, and Environmental Education, contact ERIC/CSMEE, Room 310, 1200 Chambers Road, Columbus, OH 43212.

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